

“High Tide or Low Tide”: *Desis bobmarleyi* sp. n., a new spider from coral reefs in Australia’s Sunshine State and its relative from Sāmoa (Araneae, Desidae, *Desis*)

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Abstract

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Spiders of the genus *Desis* Walckenaer, 1837 (Araneae: Desidae) are water-adapted spiders and live in the intertidal zone on reefs, marine debris and under rocks. Here, we describe a new intertidal species from tropical Queensland and name it after Bob Marley, whose song “High Tide or Low Tide” inspired us as it lives in a “high tide low tide” habitat. We also re-describe a close morphological relative, *Desis vorax* L. Koch, 1872 from Sāmoa. This species was described some 150 years ago from the Godeffroy Collection which holds the oldest major collection of Australasian and Pacific spiders, now mainly hosted in the Centre of Natural History in Hamburg (CeNak). A third species, *Desis hartmeyeri* Simon, 1909, was described from juvenile specimens only and is considered a *nomen dubium*.

“None but ourselves can free our minds.”

Bob Marley, Redemption Song (1980).

Introduction

When Amalie Dietrich travelled from Europe to Australia in 1863 she not only attempted to collect animals and plants for the museum trade, but also sought independence and liberty. A strong-headed and adventurous woman by nature, she seized new opportunities and took risks on a then-unexplored continent to elevate herself from poverty and oppression. Her life story is that of adventure and also life’s struggles and how to overcome them (Bischoff 1931). The Godeffroy Collection of arachnids, accumulated by her and other explorers over a decade in Australia and the Pacific before the turn of the 20th century, is the primary taxonomic reference for spiders of Australasia and remains highly relevant until today (Weidner 1959, 1967).

Reggae legend Bob Marley certainly had a different background but shared with Dietrich and other explorers some character traits: adventurous and resilient at heart, he liberated himself and his peers from poverty and hopelessness. He took to music, not nature, but left traces through songs that teach optimism and independence of the mind, rather than hate and passive endurance. The song ‘High Tide or Low Tide’ promotes love and friendship through all struggles of life. It is his music that aided a field trip to Port Douglas in coastal Queensland, Australia, to collect spiders with a highly unique biology.

Intertidal spiders of the genus *Desis* have a remarkable biology in that they are truly marine animals (Mcqueen and McLay 1983; Mcqueen et al. 1983). The known species hide away in barnacle shells, corals or the holdfasts of kelp during high tide where they built air

chambers from silk, but are vagrant hunters of other invertebrates during low tide and typically collected from the surface of intertidal rocks, corals, debris or plants (Mcqueen and McLay 1983, Vink et al. 2017). Some other spider families, such as *Paratheuma* in the family Dictynidae (Beatty and Berry 1988), share a similar biology but overall this is a rare pattern amongst spiders that are otherwise terrestrial animals.

It is the unique Godeffroy Collection of Australian and Pacific spiders at the Centre of Natural History in Hamburg, which contains almost all of the spiders collected by Amalie Dietrich, and also the first desid to be described from this part of the world. Three species were described in 1872 as part of the first major monograph on Australian spiders "*Die Arachniden Australiens*" which was compiled for more than a decade by distinguished arachnologists Ludwig Koch and Duke Eduard von Keyserling (Koch and Keyserling 1871–1883). Both arachnologists received the material from the Godeffroy Museum for taxonomic research and the desids were originally collected from Singapore, New Guinea and Sāmoa. Soon after, additional specimens were collected from Australia (Hector 1877, Pocock 1902) but surprisingly little is still known about the distribution and richness of these interesting spiders along the vast coastlines of this continent (ALA 2017; Framenau et al. 2014; Paquin et al. 2010; Whyte and Anderson 2017). Two species are currently known from Australia: *Desis hartmeyeri* Simon, 1909 from Albany in south-western Australia and *D. kenyonae* Pocock, 1902 from south-eastern Australia in Victoria and Tasmania (World Spider Catalog 2017, Framenau et al. 2014). However, at least *D. hartmeyeri* is an enigmatic species and no faunistic or taxonomic entries were made since the time of the original description (Simon 1909).

The present paper revisits some of the intertidal species of *Desis* in Australia by re-examination of material of the Godeffroy Collection, but also details the discovery of a new species from Port Douglas near Cairns in Queensland. The new species was identified during a collecting trip along the coastline of Australia's, "Sunshine State" (Fig. 2B). Two adult *Desis* specimens (Figs 1, 2D) were found on brain coral (Fig. 2C) at extremely low tide on a reef that is at high tide often more than 3 m under water (Fig. 2A). The male of this new Australian species is similar to *Desis vorax* found in the Collection of CeNak. This species was described as a single specimen from Sāmoa more than 150 years ago but has not been recorded or properly illustrated since.

In this paper we describe Bob Marley's, intertidal spider from Queensland, a species that can live in "High Tide or Low Tide" of extreme habitat, and clarify the status of two other poorly-known species, one from the Godeffroy Collection and a second from south-western Australia, both deposited in CeNak, through detailed re-examinations of the specimens used for the original descriptions. Both species have been preserved for more than a century but not been studied in detail since their

discovery. By doing so, we honour those that emancipate themselves from oppression, mental or organisational, and seek freedom and independence.

Material and methods

Recent specimens of *Desis* were collected and stored in 75% EtOH. All specimens were examined in 75% EtOH using a Leica M 205 A microscope. The female genitalia were dissected, cleared with Pancreatin (Álvarez-Padilla and Hormiga 2007) at room temperature and then imaged. Multiple images in different focal planes were taken with a Leica DMC 4500 digital camera and combined with the stacking software AutoMontage Pro Version 5.2. Plates were assembled in Adobe Photoshop Version 13.0.6. All measurements are in millimetres. Abbreviations are as follows: ALE anterior lateral eye; AME anterior median eye; C conductor; CD copulatory duct; CP conductor plate; DTA distal tegular apophysis; E embolus; FD fertilization duct; MTA median tegular apophysis; PLE posterior lateral eye; pl/pw prosoma length / prosoma width; PME posterior median eye; RTA retrolateral tibial apophysis; S spermatheca; sl/sw sternum length / sternum width. Institutions containing specimens are as follows: QM, Queensland Museum Brisbane, WAM, Western Australian Museum Perth, ZMB Zoological Museum Berlin and ZMH, Zoological Museum Hamburg (CeNak). Google Earth was used to determine geographic coordinates for historical specimens and only represents approximate locations.

Systematics

Family DESIDAE Pocock, 1895

Subfamily Desinae Pocock, 1895

Desis Walckenaer, 1837

Desis bobmarleyi sp. n.

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Figures 1, 2D, 3, 4, 7A–D

Material examined. MALE HOLOTYPE (QMS107379), from Queensland, near Port Douglas, 16°29'S, 145°27'E, 11 Jan 2009, R. Raven; FEMALE ALLOTYPIC (QM S107380), same as previous. PARATYPES. Queensland: 1 male (QM S13471), Bushy Island, Great Barrier Reef, 23°50'S, 151°19'E, June, 1975, D. Gleeson; 1 female (CeNak ZSMH-A0000950, ex QM S13843), Cape Tribulation, 16°04'S, 145°25'E, coral, 26 Aug 1988, R. Raven, T. Churchill, J. Gallon; 1 male (QM S60881), Cape Tribulation, 16°04'S, 145°25'E, 19 Jul 1992, M. Filmer; 1 female (QM S13477), Coconut Beach, N end, Lizard Island, LI-18, 14°39'S, 145°27'E, 7 Jun 1987, P. Davie; 1 female (QM S13474), Heron I, 23°27'S, 151°55'E, 10 Apr 1976, D. Holdick; 1 female (QM S13472), Kissing Pt, Townsville, 19°13'S, 146°47'E, rock, 11 May 1976, D. Holdick; 1 female (QM S13473), Kurrimine, south of



Figure 1. Life image of *Desis bobmarleyi* sp. n. female allotype (Photo: R. Raven).

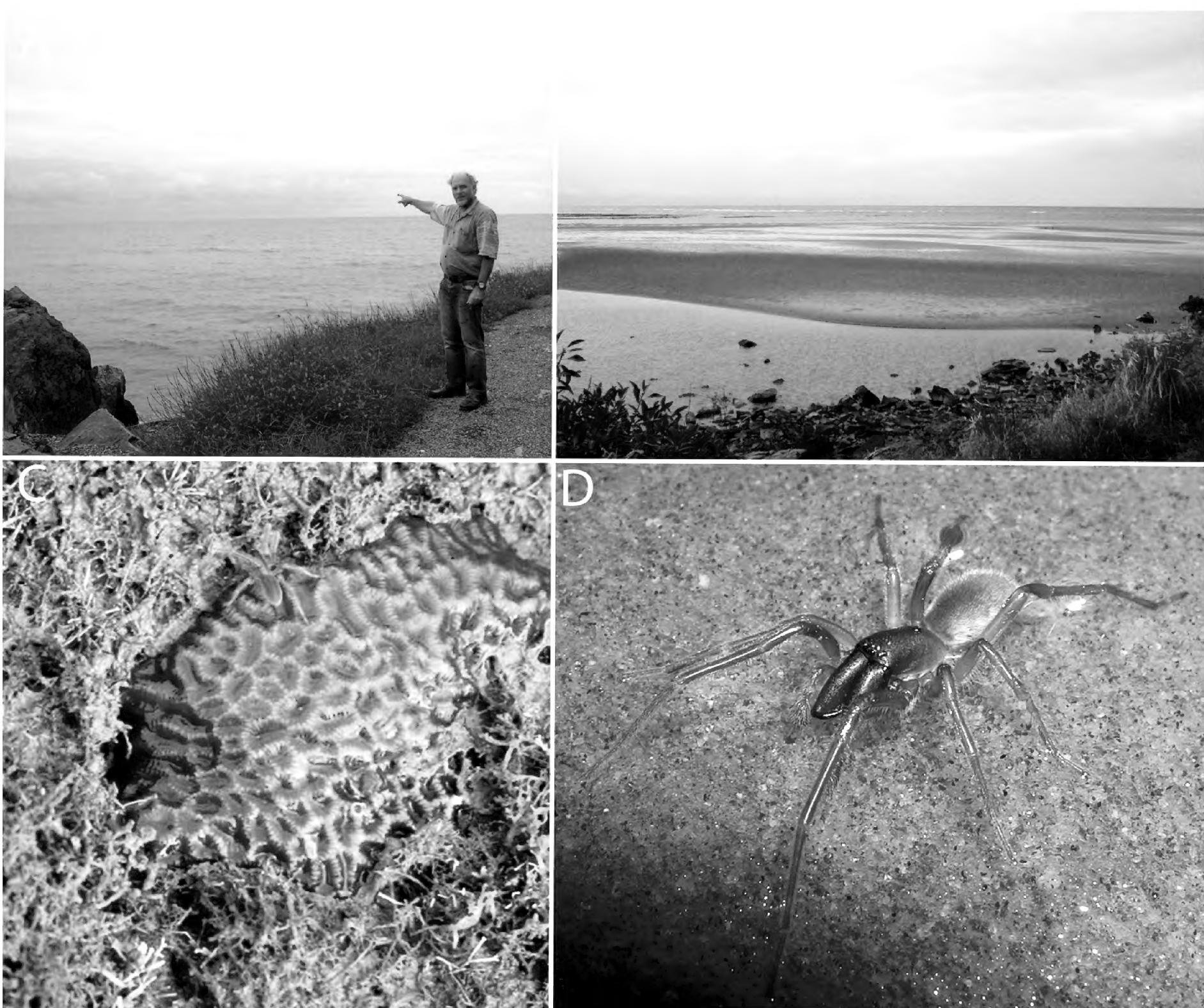


Figure 2. Locality and life images of *Desis bobmarleyi* sp. n.: **A**, beach near Port Douglas high tide; **B**, same low tide; **C**, *Desis bobmarleyi* sp. n. on coral at low tide (photo: Paul Hoye); **D**, *Desis bobmarleyi* male holotype (photo: R. Raven).

Innisfail, 17°46'S, 146°05'E, 18 May 1976, D. Holdick; 1 female (QM S13470), Tryon Island, 23°14'S, 151°47'E, 21 Aug 1977, Mrs Jahnke.

Etymology. The specific name is a patronym in honour of Bob Marley, an internationally renowned Jamaican Reggae singer and songwriter.

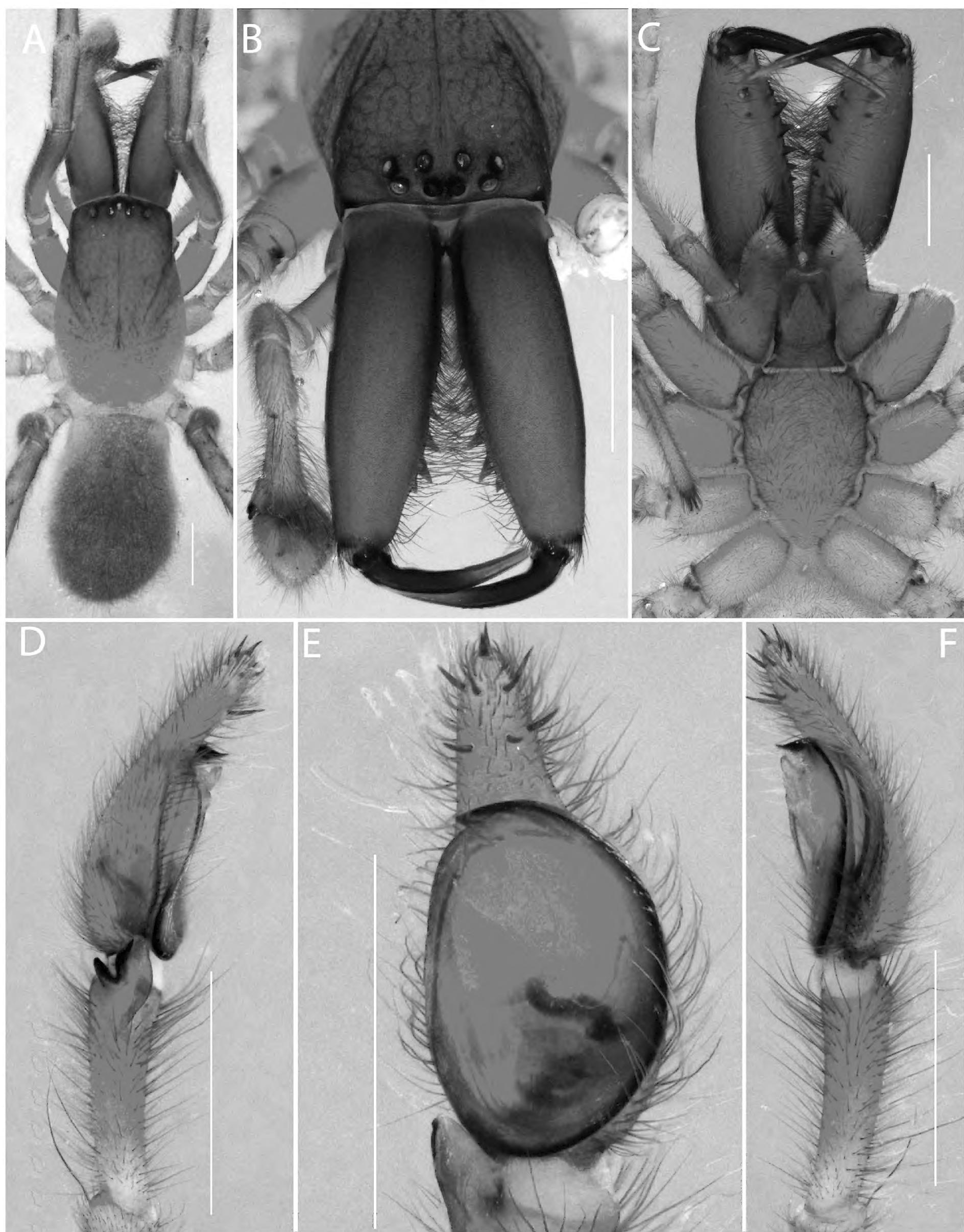


Figure 3. *Desis bobmarleyi* sp. n., male holotype (QM S107379): **A**, habitus, dorsal view; **B**, chelicerae, frontal view; **C**, prosoma, ventral view; **D**, male pedipalp, retrolateral view; **D**, same, ventral view; **E**, same, prolateral view. Scale bars: 1.0 mm.

Common name. We propose Bob Marley's Intertidal Spider as a common name.

Diagnosis. Males of *Desis bobmarleyi* sp. n. resemble *D. kenyonae*, *D. marina* and *D. vorax* in having a broad,

semicircular conductor with a retrolateral conductor plate, a hood-shaped DTA and a spine-like MTA but can be separated from these by having a broadly triangular conductor plate (CP), a stout conductor tip and an



Figure 4. *Desis bobmarleyi* sp. n., female allotype (QM S107380): **A**, habitus, dorsal view; **B**, habitus, lateral view; **C**, 4th right tarsus; **D**, chelicerae, frontal view; **E**, prosoma, ventral view; **F**, epigyne, ventral view. Scale bars: habitus 1.0 mm, epigyne 0.1 mm.

indented hood-shaped tip of the retrodistal apophysis (DTA) (Figs 3E, 7A, B). Females of *Desis bobmarleyi* sp. n. share the long convoluted copulatory ducts but have them arranged spherical not longitudinal (Fig. 7D).

Description. Male (Holotype, QMS107379) (Fig. 3A–F). Total length 6.03. Prosoma 3.01 long, 2.02 wide, pl/pw 1.49; sternum 2.00 long, 1.5 wide, sl/sw 1.33; opisthosoma

3.02 long, 2.03 wide. Eyes, subequal in size, both eye rows straight; ALE 0.12; AME 0.12; PLE 0.11; PME 0.11; AME-AME 0.08; ALE-AME 0.10; ALE-PLE 0.09; PLE-PME 0.17; PME-PME 0.18; clypeus 0.06 high with undivided chilum. Prosoma red-brown, with reticulated pattern, long rectangular; fovea short, 0.05 of prosoma length; pars cephalica flat in lateral view, in dorsal view

anteriorly narrowed to 0.82 of its maximum width, with rounded posterolateral corners, surface finely reticulate. Chelicerae, paturon reddish brown, strong elongated, longer than sternum, with 7 strong prolateral and 2 retrolateral teeth, fangs 0.8 the length of paturon. Endites, labium and sternum orange brown, labium trapezoid, medially indented; endites long with sharp triangular tip 1.3 times as long as labium, serrula absent; sternum cordate, with precoxal and intercoxal sclerites, first between endite and coxa I. Opisthosoma pale grey and covered with a dense layer of long, thin and dark grey setae; venter pale, tracheal spiracle distinct, distance from spinnerets 0.5 mm. Legs orange-brown with a dense layer of long, thin and dark grey setae, all tarsi with 3 claws, 3rd claw about 1/3 dorsal claws, paired claws on I with 10 teeth, II with 7, III with 3, IV with 12 teeth. Palp (Figs 3D–F, 7A, B): cymbium pear-shaped, longer than wide, with slight sclerotisation on retrolateral margin, covered with long setae and 7 thick spines in distal third; conductor large elliptical with broadly triangular sclerotized CP and stout tip, embolus thin, semicircular, covered by conductor, median apophysis thin needle-shaped, retrodistal apophysis with indented hood –shaped tip. RTA medially indented and ventrally slightly s-shaped.

Female (allotype, QM S107380) (Fig. 4A–F). Total length 8.82. Prosoma 3.95 long, 2.43 wide, pl/pw 1.62; sternum 2.00 long, 1.50 wide, sl/sw 1.33; opisthosoma

4.87 long, 3.05 wide. Colour and habitus as in male; ALE 0.11; AME 0.11; PLE 0.11; PME 0.11; AME-AME 0.08; ALE-AME 0.10; ALE-PLE 0.09; PLE-PME 0.17; PME-PME 0.18. Clypeus 0.05 high. epigyne (Figs 4F, 7C, D): with M-shaped sclerotised region, posterior margin with small median u-shaped process and long convoluted copulatory ducts arranged spherical, ending in globular spermathecae about their diameter apart.

Distribution. Known from intertidal zones of the Great Barrier Reef at the north-eastern coast of Queensland: Australia's "Sunshine State". The exact distribution range along the coastline of Australia is still unknown.

Desis hartmeyeri Simon, 1909, nomen dubium

Figure 5A, B

165 *Desis hartmeyeri* Simon, 1909, Südwest-Australien, Albany, 13–22 August 1905, Syntype (Rack 1961).

Material examined. JUVENILE FEMALE SYNTYPE (ZMH-A0000100), from Western Australia, Albany, 35°1'S, 117°53'E. 2 JUVENILE FEMALE SYNTYPES (ZMB), ONE JUVENILE SYNTYPE (WAM)

Remarks. The description of this species was based on juvenile specimens (Rack 1961; York Main and

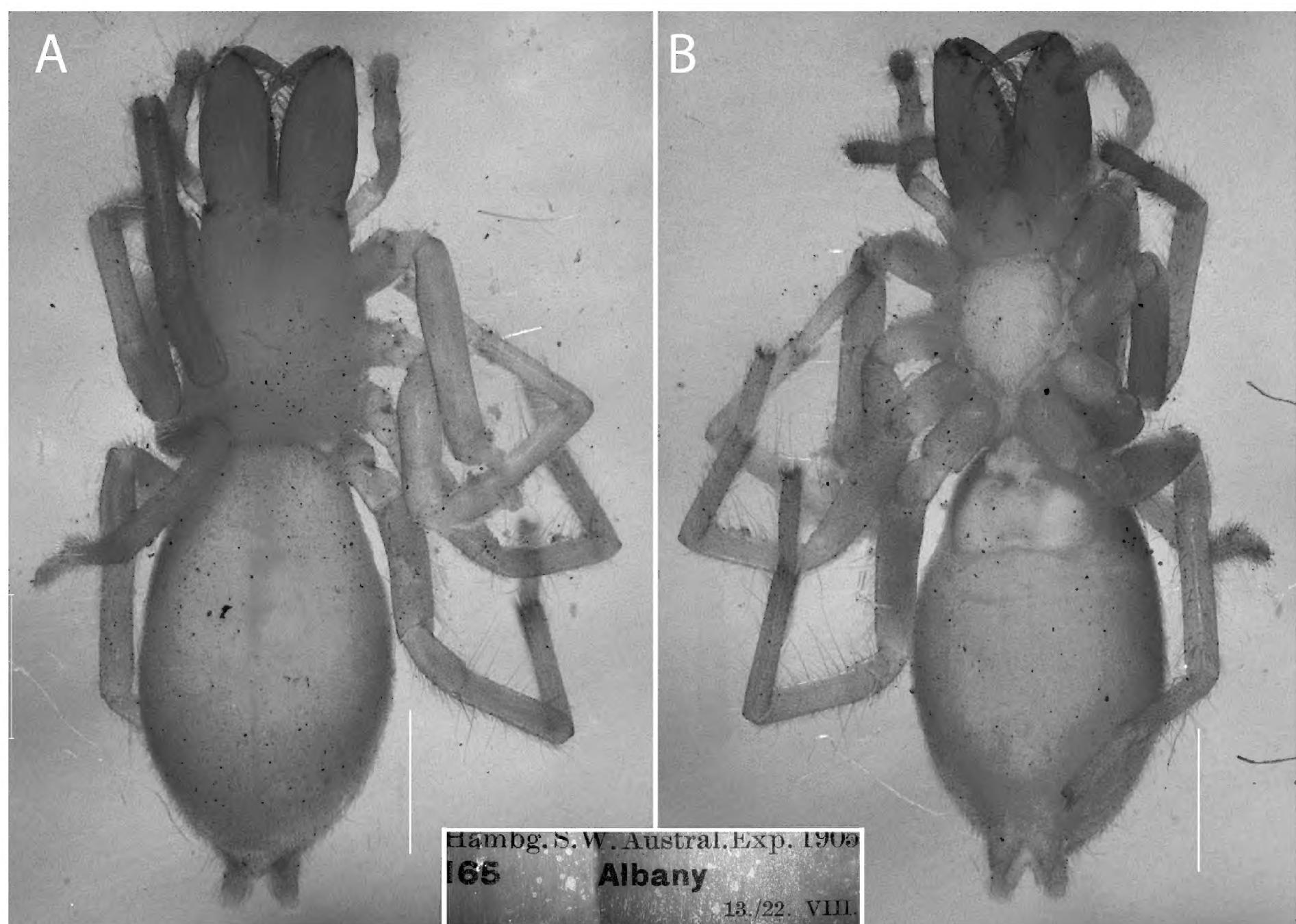


Figure 5. *Desis hartmeyeri* Simon, 1909 female syntype juvenile (ZSMH-A0000100): **A**, habitus, dorsal view; **B**, habitus, ventral view. Scale bars: 1.0 mm.

Harvey 1992) and the four juveniles are deposited at three museums: one in Hamburg, two in Berlin and one in Perth. Simon (1909) did not designate a holotype and all four specimens are treated here as syntypes. The identification of species in morphologically conserved groups of spiders, such as Desidae, inevitably requires adult specimens and *D. hartmeyeri* cannot be reliably identified based on these specimens and may be synonymous with some of the other Australian species for which adult specimens are available. No additional information on this species – biological, distributional or taxonomic – is available that could elucidate its status. The collection locality is geographically distinct (all other records are from eastern Australia) but many *Desis* species have wide ranges and the specific habitat is not strongly distinct from any such habitats in south-eastern Australia. The purpose of a species description is to facilitate species identification but this is not possible from the data available and the specific name adds to taxonomic redundancy in this group of spiders. This species is a *nomen dubium*.

Desis vorax L. Koch, 1872

Figures 6A–F, 7E, F

169 *Desis vorax* L. Koch, 1872, 345–346, Taf. 29 fig. 1–1, Sāmoa-Inseln, Upolu, male Holotype (Mus. GODEFFROY Nr. 6538) (32) (Rack 1961).

Material examined. MALE HOLOTYPE (ZMH-A0000099), from The Independent State of Sāmoa, Upolu, 20°15'N, 155°51'W, Godeffroy Collection.

Diagnoses. Males of *D. vorax* can be separated from other *Desis* species, including *D. bobmarleyi*, *D. marina* and *D. kenyonae*, by having a slim, triangular conductor plate (CP) and a slender conductor tip (Fig. 7F).

Description. Male (Holotype, ZMH-A0000099). Total length 5.85. Prosoma 3.47 long, 2.23 wide, pl/pw 1.55; sternum 1.55 long, 1.38 wide, sl/sw 1.12; opisthosoma 3.30 long, 2.14 wide. Eight eyes in two rows; AME 0.12; ALE 0.14; PLE 0.16; PME 0.17; AME–AME 0.11; ALE–AME 0.12; ALE–PLE 0.05; PLE–PME 0.17; PME–PME 0.20. Clypeus 0.04 high. Prosoma pale bleached, long rectangular, anteriorly straight; fovea short, 0.05 of prosoma length. Chelicerae paturon pale, bleached, strong, elongated, longer than sternum with 5 strong prolateral teeth, fangs 0.9 the length of paturon. Endites, labium and sternum pale bleached, labium trapezoid medially indented, with lateral sinuous margin; endites long with sharp triangular tip, double as long as labium; opisthosoma pale bleached with dark brown markings laterally and a median band scattered in triangles; venter pale. Legs pale, bleached, all tarsi with 3 claws, 3rd claw about 1/3 length of dorsal claws, both dorsal claws with about eight strong teeth. Body covered with long pale setae. Palp (Figs 6D–F, 7E, F): cymbium pear-shaped, longer than wide, with slight sclerotisation on retrolateral margin covered with long

setae and 5 thick spines in distal third; conductor large, elliptical with slim, triangular sclerotized CP and slender tip, embolus thin, semicircular, covered by conductor, median apophysis thin needle-shaped, retrodistal apophysis with hood-shaped tip. RTA medially indented and ventrally straight.

Distribution. Currently known only from Upolu, one of the islands of the Independent State of Sāmoa. The wider distribution of this species is still unknown but it may be more widespread across the islands of Sāmoa.

Remarks. Apparently, this species has not been re-collected since its original discovery but may have been overlooked because it is found in habitats that are not usually associated with spiders.

Discussion

Biology of *Desis bobmarleyi* sp. n.

The first specimens were recorded in northern Queensland in the 1970s and early 1980s from specimens that were active during the day amongst intertidal rocks that were exposed only at low tide. Further observations were made on flat reefs and in a lagoon where the spiders were found under loose live and dead corals (*Acropora* sp.). A thin film of silk was noted in the concavity of the underside of the coral and these may have been remains of the silken retreats during high tide. The spiders were within 20 m of the shoreline and the area would be flooded up to 3 m during high tide. Recently, Mr Paul Hoye, then of the Cairns Municipal Council, brought to our attention a population at Port Douglas north of Cairns. The spiders were found on an inshore reef, about 600 m from shore. Mr Hoye noted that he was only able to find the spiders because the tide was exceptionally low. By searching at such a low tide, two of the authors (RJR, BB) were able to confirm the sighting and take a male and female that were active at a very low tide on 11 January 2009 at night at 2am.

The Godeffroy Collection of spiders

Historical taxonomic collections provide the reference and context for current biodiversity studies, in particular if they are rich in type specimens. The Godeffroy Collection of arachnids at the CeNak is an important historical source and comprises several hundred type specimens of arachnids from all over the world, including more than 450 types from Australia and the Pacific Islands (Weidner 1959). It is the legacy of Amalie Dietrich, an emancipated woman of remarkable independence, that has been preserved for more than 150 years, although many other adventurers and explorers have contributed to this collection. Compiled on behalf of Johann Cesar VI Godeffroy for his private Museum Godeffroy in Hamburg from 1861 to 1885, this is arguably the oldest major collection of arachnids from Australia and still one of the primary taxonomic resources for

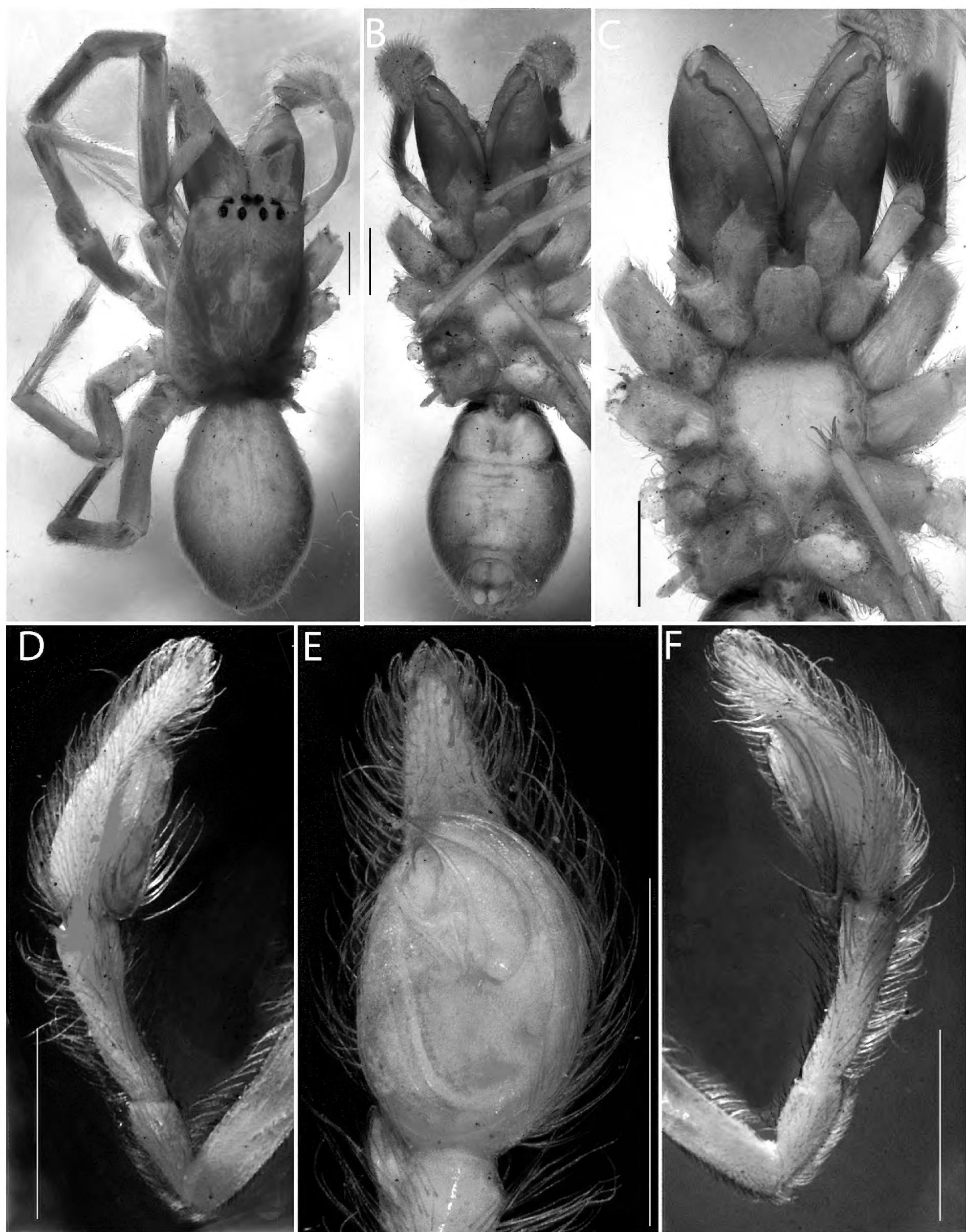


Figure 6. *Desis vorax* L. Koch, 1872, male holotype (ZSMH-A0000099): **A**, habitus, dorsal view; **B**, same, ventral view; **C**, prosoma, ventral view; **D**, male palp, retrolateral view; **D**, same, ventral view; **E**, same, prolateral view;. Scale bars: 1.0 mm.

their study in this region. The current study is another example, amongst others (e.g. Baehr et al. 2017), that highlights the essential character of this collection for present-day taxonomy.

Towards a stable taxonomy for *Desis* species

There is currently no taxonomic revision for the world-wide-distributed spiders of the genus *Desis*, which are found on the reefs along many coastlines around the world.

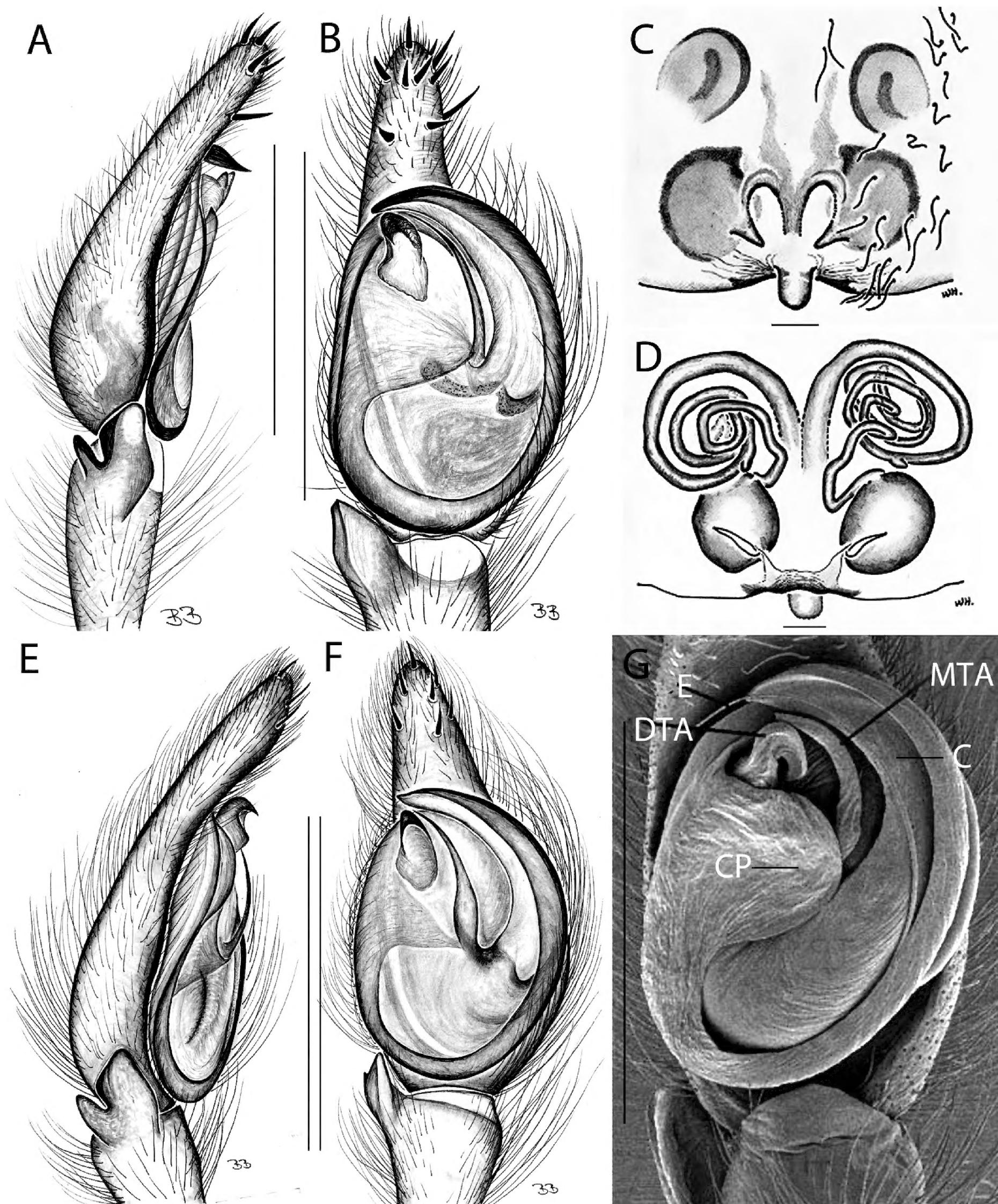


Figure 7. *Desis*: A–D, *Desis bobmarleyi* sp. n., male holotype (QM S107379), female allotype (QM S107380) A, palp, retrolateral view; B, palp, ventral view; C, epigyne, ventral view; D, epigyne, dorsal view, cleared; E, F, *Desis vorax* L. Koch, 1872, male holotype (ZSMH-A0000099); E, palp, retrolateral view; F, palp ventral view; G, *Desis formidabilis* (O. Pickard-Cambridge, 1891), SEM, palp, ventral view (ex. Griswold et al., 2005, fig. 177 B). Abbreviations: C, conductor; CP, conductor plate; DTA, distal tegular apophysis; E, embolus; MTA, median tegular apophysis. Scale bars: palps 1.0 mm, epigyne 0.1 mm.

All species within this genus that are known from both sexes share a similar morphology of the male and female genitalia but are also very conserved at the somatic level and appear to be closely related at the morphological level.

The similarities between most described species and the relatively low species numbers (13 species are currently recognised worldwide) may be caused by the specifics of the marine habitat that allows for dispersal across wide

distances, but may also indicate ecological constraints that lead to morphological similarity. At least some species appear to have wide ranges and may disperse across wide distances within the aquatic habitat, such as *Desis marina* (Vink et al. 2017). Some species may be global tramps that have a very wide distribution but, due to their unique biology, often go unnoticed. Others are clearly habitat specialists that may be more tightly restricted but their biology is still poorly known, e.g. *Desis kenyonae* (Hickman 1967) that has been collected from seaweed in south-eastern Australia and may be restricted to the cool waters near the Bass Strait and Tasmania.

A detailed molecular analysis of all *Desis* species, including more detailed analyses of spatial distributions and molecular data, is suggested here to test for dispersal capacities, species boundaries beyond morphology, and ecological speciation scenarios rather than vicariance that is generally evoked as a cause for speciation scenarios in terrestrial spiders. In this context, we also notice that the SEM image of *Desis formidabilis* (Griswold et al. 2005) (Fig. 7G) from South Africa shows a very similar pedipalp structure to *Desis bobmarleyi* sp. n. from Queensland and *Desis vorax* from Sāmoa, although there are notable small differences in pedipalp spination and the shape of the CP and MA. These species are closely-related at the morphological level but genetic analyses may show a very different pattern of divergence across the Indian Ocean. Overall, the current study is an essential prerequisite towards a comprehensive taxonomic treatment of *Desis* at both, the species- and genus level because it illustrates morphological key characters and type specimens, eliminates some of the taxonomic difficulties arising from old descriptions, and adds some basic biological information on the Australian and Pacific fauna.

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